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P/382-152

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

John Allen HILTON

Serial No.: 10/532,516

Filed: April 25, 2005

For: THREE-DIMENSIONAL FORCE AND TORQUE CONVERTER

Confirmation No.: 8700

Date: November 2, 2009

Group Art Unit: 3661

Examiner: Sze-Hon Kong

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**VIA FACSIMILE 571 273 8300**

Commissioner for Patents

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Alexandria, VA 22313-1450

**ADDITIONAL COMMENTS FOLLOWING TELEPHONE INTERVIEW**

Sir:

Pursuant to the telephone contacts between the undersigned attorney and the Examiner on October 20 and 22, 2009, following are additional comments concerning the Amendment filed August 14, 2009.

First, the applicant confirms that, as the Examiner suggested, where pages 10-11 of the Amendment refer to "Hilton" or "Hilton's device" they are referring to the device defined in the present claims, of which Hilton is the named inventor.

In other words, these pages are *not* referring to the Hilton patent, US Patent 5,798,748 (hereinafter "US 5,798,748").

As amended, independent claim 1 recites, in part: "*only four arms* extending from the body portion, the arms being spaced from one another ...; four connection joints, each connection joint engaging one of the [arm] tip portion to restrict relative motion of the four arms within the controller device ...; a response detector operable for monitoring responses to the applied force

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and applied torque in at least three of the four arms ....” Independent claim 10 has similar limitations.

US 5,798,748 does not disclose or suggest the claimed four-arm arrangement, which is simpler than the arrangements known to the art.

The US 5,798,748 device mechanically resolves spatial force and spatial torque into six single-dimensional forces, forming three force-moment pairs, each pair being perpendicular to the other two pairs. In one embodiment the forces lie in the six faces of a cube. The six forces are completely independent of each other. The device has six degrees of constraint and so is perfectly constrained. The computational requirement is very simple, with the three pairs of sums producing the three force vector outputs and the three pairs of differences producing the three torque vector outputs.

The devices of claims 1 and 20, however, mechanically resolve the spatial force and spatial torque into *four* two-dimensional forces lying in the faces of a tetrahedron, a total of eight force components. As there can only be six degrees of freedom between any two rigid bodies, there are two degrees of interdependency in the claimed device. This interdependency results in differences to US 5,798,748, both mechanically and computationally.

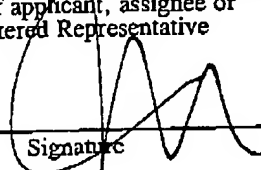
Mechanically the claimed device has eight degrees of constraint and so is overconstrained, which means that any geometrical variation in production will result in a small preloading of the four arms. A small amount of preloading is beneficial in that it minimizes rattle and dampens vibrations. The interdependency also increases the computational complexity to calculate the force and torque output vectors, given the eight force components of the two-dimensional deflections of the four arms.

Further, the claimed device uses this interdependency to require only six measurements of the eight force components, and calculates the remaining two. This feature trades-off increased computational complexity for reduced cost, by eliminating two sensors. The added computational complexity is easily handled by modern microprocessors.

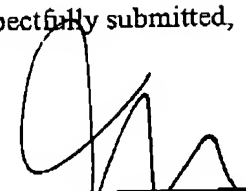
The four arm arrangement of the present claims provides several additional advantages. For one, it permits an embodiment with fewer components. It can be embodied by the injection molding of a very low cost single plastic component having the four arms, the part-spherical arm tips, a rigid mounting structure for the four arms and mounting features for the three sensor PCB assemblies. This compares with the three types of more expensive commercial devices based on US 5,798,748, each requiring over eight components to provide the same functionality. The simplicity provided by the four arm arrangement has considerable cost advantages over the embodiments of US 5,798,748.

Accordingly, there are significant technical differences between the devices of the present claims 1 and 10 and the devices disclosed in US 5,798,748. Even in combination with the other cited references, US 5,798,748 neither discloses nor suggests the subject matter of claims 1 and 10 and their dependent claims.

I hereby certify that this correspondence is being facsimile transmitted to the Patent and Trademark Office, on November 2, 2009:

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Name of applicant, assignee or  
Registered Representative  
  
Signature  
November 2, 2009  
Date of Signature

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